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ABSTRACT

A model for forecasting postsecondary enrollment, the PDEM-1, is considered, which combines the traditional with a cross-pressure impact decision-making model. The model is considered in relation to its background, assumptions, survey instrument, model conception, applicability to educational environments, and implementation difficulties. The model has been subjected to three years of research, development, validation, and external evaluation. The survey instrument consists of two instruments designed to follow the student's decision-making and assess dimensions of change and reasons for change occurring since the last contact. Academic and occupational plans, family influence and background, financial situation, and summer plans before college entry are among the areas tapped by the survey instrument. The model includes a pure demand report, which represents students' intentions to enroll in postsecondary education, and actual enrollment forecasts, which represent those students anticipated to persist in spite of constraints, such as academic eligibility. The model can review enrollment outcomes by institution and program as decision-making variables are changed. The following concerns relating to application of the model are examined: costs and benefits, budgeting, program planning, comprehensive educational planning in a transitional environment, representativeness of the sample, systems level application, size and accuracy, and full-time students. Implementation problems are also considered. (SW)

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POST-SECONDARY ENROLMENT FORECASTING

WITH

TRADITIONAL AND CROSS PRESSURE-IMPACT METHODOLOGIES

BY

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INTRODUCTION

What's it all about; with this on-going time series of assessments focused on student aspirations, intentions, motivations and other profile characteristics which then follow the students' decision-making process from the "pure demand" through the existing institutional supply, quotas, waiting lists, etc. to the final selection of an option to go or not to go on to post-secondary. It's all about change in Manitoba and elsewhere in North America, change in the recent past, in the present and in the emerging future. It's about change which has come too fast for adaptation by many individuals and their institutions. It's about change in the absence of methodologies capable of describing, explaining and forecasting a world in transition.

It is a fundamental responsibility of those charged with provincial or statewide educational planning to assess changes in the aspirations of future students and related needs of Society. Based upon these assessments and their inter-relationship with the existing educational supplies, the planner first arrives at a sense of the whole as more than simply the sum of its parts. Secondly, he identifies and priorizes his goals; thirdly applying objective analysis he rationalizes approaches and fourthly in response to the outcomes of the earlier steps he preserves or changes budgets, programs and institutional roles. However, if the traditional methodologies for assessment show repetitive signs of faltering under the onslaught of change in the very first step, it is only a matter of time before disorientation and a crisis of confidence result in the educational community. In effect, the result is reflective of Alvin Toffer's "future shock" and what the Carnegie Commission refers to as "a traumatic loss of a sense of assured progress".

After three years of research, development, validation and external evaluation, it now appears that the methodological gap left by the rapidity of change may be partially filled by a comprehensive forecasting model which combines the traditional with a cross-pressure impact decision-making model. In addition to passing its research and development period, the model referred to as PDEM-1 has been providing forecasts for full-time university enrolments in Manitoba for the years 1972, 1973 and 1974, all of which were well within the prescribed tolerances of 2% target error at -.2%, -1.4% and +.2% respectively.

In the following paragraphs this comprehensive methodology and its model will be explored in terms of its background, assumptions, survey instrument, model conception, applicability to educational environments, implementation difficulties and summary observations.

BACKGROUND:

Prior to 1971, the body of research on student decision-making for post-secondary selection and forecasting indicated a gap between intentions and actual enrolment behaviour which was too unpredictable for forecast applications. At the time of the first appearance of the post-secondary enrolment crisis, the author was a Research Associate with the Ontario Institute for Studies in Education with an assignment to explore the applications of simulation methodologies to differential socialization outcomes in elementary and secondary school environments. This research led to consideration of a number of simulations involving relatively abrupt changes in individual and group behaviour resulting from cross-pressures, impact events, conflicting alternatives and related socio-economic circumstances. While research on behavioral simulation for forecasting educational enrolments were at best viewed as experimental[1], the author's awareness of existing applications to market place consumers and election voter behaviour combined with the author's conception of how the poorly informed student decision-maker component might be overcome, thereby indicating a high potential for workability. Shortly thereafter, the opportunity for practical application appeared in Manitoba, Canada although not without skepticism for the proposed undertaking.

ASSUMPTIONS:

Offsetting the encountered skepticism were a number of informed assumptions about the status of prior research, student post-secondary decision-making circumstances and the applicability of the cross-pressure impact methodology:

1) It was assumed that prior research had identified a number of profile characteristics such as family background and influence related to parent's education, income, peer group influence, prior academic performance, etc. so that utilizing prior research findings a majority of the twelfth grade students could be split into either "going" or "not going" on to post-secondary education.

2) It was hypothesized that 20 to 30% of the twelfth grade class might appear as "undecided" with responses to cross-pressures and conflicting alternatives over options favouring both "going" and "not going" on with their education. The three years of application in Manitoba would later indicate that the undecided group for the period of November to February varies from 14% to 18% of the total population.

3) In the decision making sequence it was assumed that most undecided students participating in November to February surveys would shortly face interim decisions to make applications for admissions and student aid and in this situation a time-series of surveys called "snapshots" might capture these interim decisions and their group tendencies. A final May Snapshot in the time-series was considered sufficient to establish the trend insight necessary to split the undecided into "going" and "not going" groups for next September.

4) Based upon prior research findings, it was assumed that many student-consumers were poorly informed as to their prospects for post-secondary admissions. In fact, so poorly informed that they were not prepared for the impending impact of rejection to their first choice institution or program.

1 WATSON, Cicely [4] Report of Survey of Canadian Users of Mathematical Models for Educational Decision Making, O.I.S.E., 1973, pages 21 and 22.

A key to the workability of this methodology is found in its ability to generate not only the pure demand side for the oncoming twelfth grade class by institution and faculty, but also to collect from each of the post-secondary institutions in Manitoba the critical inputs for the supply side in the form of first year enrolments and constraints. A sub-system model could then produce the "supply-demand matrix" which would identify students facing probable admission choice rejection - re-simulate and re-evaluate the student's second and third choice for "going" as opposed to "not going" options until a probable decision split was achieved. And thereby, much of the unacceptable gap between intention and behaviour identified by prior research could be resolved.

5) It was assumed that the student's self-reported grade point averages in Grades XI and thus far in Grade XII would be reliable and provide quantifiable degrees of escalation when compared with the actual institutional grade reports. If this assumption held, it formed the basis in combination with the supply/demand matrix to generate the approximate grade point selection cut-offs for each institution and faculty which had a surplus of eligible students seeking admission.

6) Prior research also indicated that many students were poorly informed about the costs of post-secondary, their prospects for Student Aid, the reliability of their financial resources and therefore, the ultimate balanced or unbalanced condition of their post-secondary budget. Fortunately, in the Manitoba situation, the Student Aid Division of the Department of Colleges and Universities Affairs, kept an annual up-date of institutional and personal costs by institution and faculty, a summer earnings report and quantifiable criteria for the student aid awards. The forecasting simulation was originally intended only to identity those students vulnerable to financial impaction. Later research and development referred to as The Post-Secondary Option Game would demonstrate the potential of actual simulation of the student's post-secondary budget and the probable student aid award using eight variables and having an accuracy within $100 of actual awards.

7) It was assumed that some of the institutions and faculties would change their supply side constraints very late in the admission process and after the creation of the supply/demand matrix and the presentation of the enrolment forecasts. It was recognized that even a slight change or re-interpretation of admission constraints can affect not only the individual faculty outcome, but frequently has a marked domino affect on other faculties and institutions. Fortunately, marked changes in admissions constraints were not undertaken during the three-year test.

8) Finally, the methodology assumes that major changes in exogenous variables such as marked inflation, repression and fluctuations in employment opportunities will not occur in the period from the last snapshot survey in May to the September enrolments. Should a major change be assessed, it would require another snapshot and a re-simulation of the "undecided" and "impacted" groupings.

SURVEY INSTRUMENT:

Development of the survey instrument is primarily attributed to the leadership of Dr. Dale Beckman, Market Research, University of Manitoba and has been successfully applied utilizing a variety of approaches ranging from personal interviews to large group applications. The instrument is in fact two link instruments designed to follow the student's decision making and assess dimensions

of change and reasons for change occurring since the last snapshot. The instrument contains batteries of questions focusing on the following areas of interest:

A. Plans of Grade XII students for the summer and for the next academic year.

B. The degree of influence which individuals, parents, high school activities and circumstances had on student decision to continue or to discontinue their education.

C. The impact of possible future events on student decisions.

D. Student aspirations, expected career choice and long range plans.

E. Background questions concerning family size, previous schooling, type of community where students grew up, etc.

F. Academic standing.

G. Student choice of institutions and programs.

H. Optional questions concerning parent's education and family income.

I. Financial situation, expected sources of financing, student knowledge of tuition fees and student aid.

MODEL CONCEPTION:

The difficult task of converting theory into an operational forecasting model called PDEM-1 was accepted by Dr. Tom Major, Faculty of Administrative Studies, University of Manitoba. The enclosed diagram pictorially describes the components comprising the forecasting model. Their highlights might be summarized as follows:

The overall conception of the forecasting model encompasses the generation of first, the pure demand report and later an actual enrolment forecast. The demand component represents the aggregate of all post-secondary demands and is comprised of current high school graduates, non-sequential students, inter-provincial and international students and transfer-in students. The pure demand reports are produced for each institution and program in the system and represents the students' intentions to enrol without regard to constraints. The actual enrolment forecasts on the other hand represent the numbers of students anticipated to survive the impaction of constraints such as academic eligibility and selection cut-offs, financial ability to meet post-secondary requirements, availability of programs chosen, availability of institutional resources to expand enrolments and institutional and governmental quotas based on existing demand in the job market.

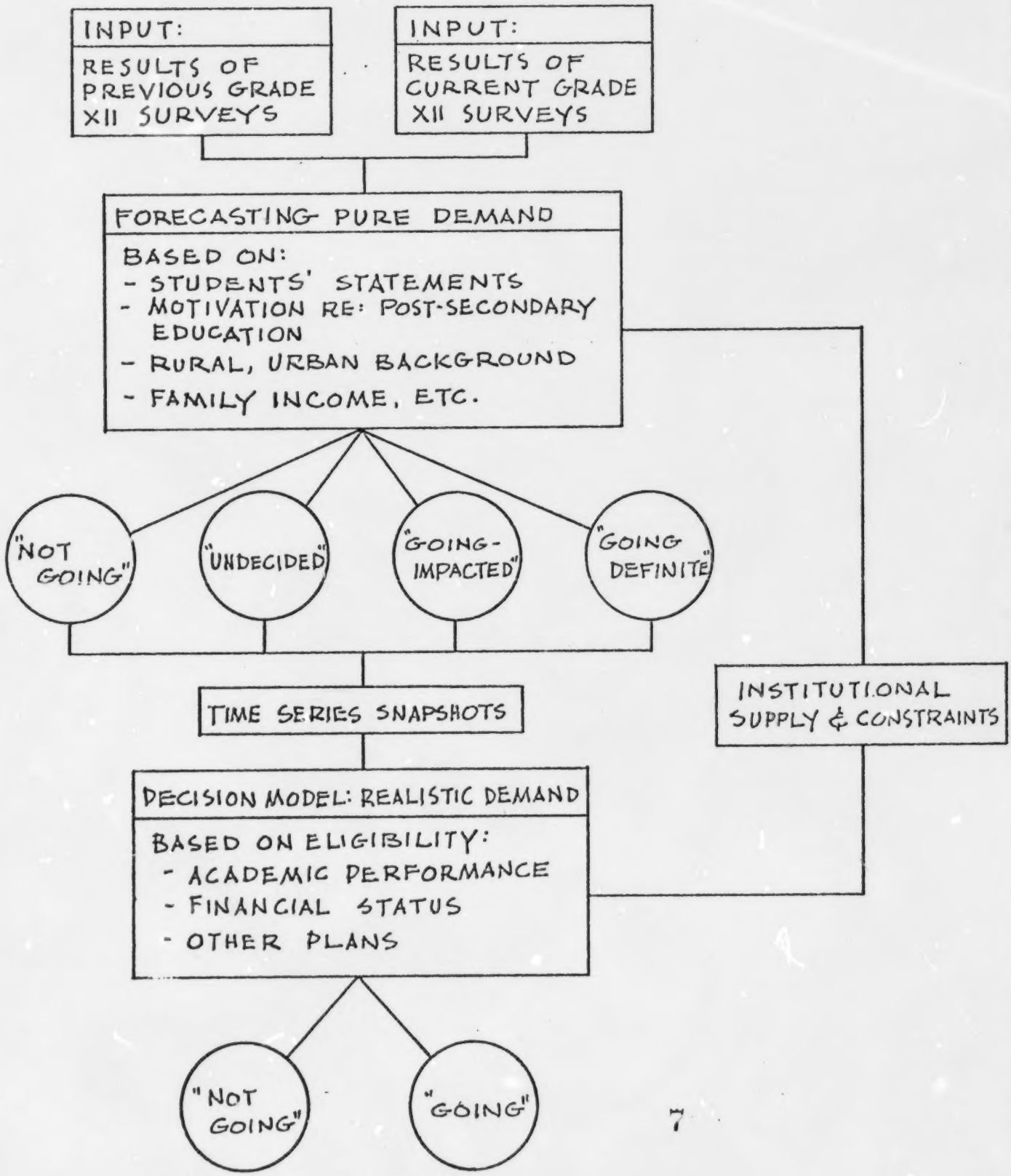
A distinguishing feature of the model design represents its interactive mode; that is, as the decision-making variables are changed or hypothesized to be changed, the model can review the impacted enrolment outcomes by institution and program. This mode is of particular value to decision-makers as the impacting consequences of change frequently extend well beyond the institutional locations of that decision.

The model conception (see diagram PDEM-1) involves five main sub models which function as follows:

Sub Model 1 analyses the results of the current survey of Grade XII students and

DEMAND AND ENROLMENT

(SUMMARY FLOW CHART)



incorporates these findings with the analysis and outcomes of earlier surveys to produce an allocation of the student population into four sub-groupings - "not going", "undecided", "going impacted" and "going definite". The definition of the term "undecided" would indicate that these are students with "going" and "not going" options which appear to have about equal strength at the time of the survey. The "going impacted" group has been defined as individuals who intend on going who, however; knowingly or unknowingly face probable impaction in terms of not being selected for admissions to their program of choice or students who face the discovery that financially they do not have the means necessary for their first year's education.

Sub Model 2 allocates the "undecided" and "going impacted" groups into either "going" or "not going" categories. If the model is being run based upon the first survey of a twelfth grade class, the split is achieved primarily based upon the historical outcomes of the previous years' Grade Twelve class divisions. If the model is being run based upon a second or third survey snapshot of the same Grade Twelve class, then the tendencies over time and the existence or non-existence of interim decisions regarding institution, program and applications become critical insights for the "going" and "not going" divisions.

Sub Model 3 now concentrates on the "going" group and estimates sequential student demand according to first, second and third choice institutions, faculties and programs. Drawing upon traditional forecasting techniques, the non-sequential, out-of-province and international students as well as transfers within institutions and between institutions are estimated in terms of their demand.

Sub Model 4 uses a linear programming technique to maximize student satisfaction with regards to their personal priorities - first, second and third choice institutions and programs but subject to various constraints such as admission standards, quotas, physical capacity and staff of the institutions.

Sub Model 5 draws primarily on traditional forecasting methodologies to estimate the second, third, fourth year undergraduate and graduate enrolments by institution, faculty and program.

APPLICABILITY TO EDUCATIONAL ENVIRONMENTS.

Costs and Benefits.

1) The research and development costs of the Cross-Pressure Impact Methodology required approximately three and a half years to complete and to arrive at a point of validation and evaluation where its workability and applicability to most educational environments appears demonstrated. These methodological costs in both time and dollars would not be required elsewhere; however, costs of developing a model which contains component weightings and the unique interactive and impacting characteristics of another educational environment would probably require a first round experimental application. The highly accurate first round forecasts in the Manitoba environment are attributed to the generally favourable initial state of the system-wide information. In an educational environment where the initial state information is less favourable, it would be reasonable to expect the costs of implementation to encompass a one year experimental to operational lag. In addition to costs for the experimental year, the cost benefit analysis envisions applicability of the methodology and its model to four alternative educational environments described in terms of their general situation and objectives as follows:

a. Macro Budgetting and Moderate Stability.

This hypothesized environment assumes fluctuations in overall enrolments about a + or - 5 percentage target with educational budgeting focused on macro enrolments and macro student costs formulation. Institutional and program enrolments fluctuate well beyond the 5 percentage point; however, these are accommodated errors within the overall system which remain moderately stable over time. It is assumed that the existing budgetting and planning approach is viewed as satisfactory and there is no desire to move towards system level or program budgetting and planning. In this environment, the traditional approaches to forecasting should perform satisfactorily and therefore the costs of the cross pressure impact methodology would seem to outweigh its limit utility.

b. Institutional Budgetting in a Plateau Environment.

This educational environment envisions a desire for moderately accurate forecasts within a + or - 3 percentage point variation and a focusing of these forecasts on institutional budgetting which are workable over extended periods, i.e. the plateau phenomena. Only occasionally, perhaps once each decade, is the stability of the plateau phenomena disrupted by major shifts in student values and options. Even when discruption does occur, a new equilibrium or plateau emerges shortly thereafter. The benefit from the cross pressure impact methodology are of course greatest in times of disruption and during the search for the new plateau. Only minimal benefits follow once the new plateau has been identified and accepted. Cross benefit analysis appears to require the introduction of two additional variables - one which relates to the size of the system and the other involves the duration of the period of transition, indecision and debate required to produce agreement on the temporary or permanent nature of the new plateau. The cost-benefit evaluation suggests that in a large post-secondary system, the costs of the experimental year plus maintenance of the cross pressure impact methodology on a stand-by basis could be offset by the benefits accruing to it by shortening the period of indecision by a single year.

c. Programmatic Planning and Budgetting.

A trend in post-secondary planning and budgetting is toward statewide or provincial-wide approaches. It is expected that the resultant system wide identification of societal needs, assessment of the current post-secondary supply capabilities and the resultant rationalization of approaches and budgetary modifications could have a major impact on both the institutional roles and the resultant enrolment patterns. Many of these decisions would produce complex multiple level interactions and spillovers on to other programs and institutions and could go undetected by simple flow model methodologies. It is the author's contention that the educational planner who is considering changing institutional roles and student flow patterns would be well advised to seriously consider the cross pressure impact methodology if for no other reason than to avoid some of the rude surprises which are sure to result from the unforeseen consequences of decisions on other decision-makers and on the eventual selection of "go" or "no go" options of students.

d. Comprehensive Educational Planning in a Transitional Environment.

This final alternative reflects the original theoretical conception

of the cross pressure impact methodology as requiring an on-going assessment of all the viable options available to our youth. The assumption is of a transitional environment where the scope of planning encompasses both secondary and post-secondary education as well as extending to decision-making involving manpower, recreation, welfare and the changing social-economic situation. The scope of planning is expanded and it now becomes important not only to forecast the outcomes and to simulate the probable outcomes but to describe and explain the reasons for changing trends. Output would focus on the life context and motivational characteristics of the students, the measurement of impacting variables and changing social structure on the students' aspirations and their eventual decisions.

The cost benefit evaluation suggests that the cross pressure impact methodology is the only operational methodology currently capable of successfully describing, explaining and forecasting the probable outcomes in a highly complex system during periods of marked transition. As such it is strongly recommended that this methodology be made available as its benefits are substantial compared to its costs.

2. Representativeness of the Sample.

A representative sample drawn from all Grade XII students appeared necessary in Manitoba and in some other educational environments due to the changeability of the students' stated intentions.

In Manitoba, for example, about 10% of students who state they are not going directly on to post-secondary, were discovered enrolled the following Fall. There is a further danger in excluding the "not going" group and missing the magnitude of emerging non-post-secondary options which overlap and impact on the "undecided", "going impacted", and "going definite" groupings. It is also possible to view the cross-pressure impact methodology as a valuable tool for comprehensive planning which extends well beyond the post-secondary into areas of manpower and back into the areas of counselling and general preparation in secondary school system. In this latter application, a representative sample is clearly desirable.

3. Systems Level Application.

Participation of all post-secondary systems and institutions is desired for the workability of the supply-demand index, the interactive mode of the model and the production of the reliable multi level enrolment forecasts. A reasonable level of forecasting accuracy may be achieved in the absence of a few "low demand" institutions. However, due to the observed activities of such institutions to change their constraints, their image and their overall market position, their participation is strongly advised.

4. Size and Accuracy.

Three years of comparing forecasts to outcomes has produced a picture of methodological performance which indicates greater accuracy favours larger size in both institution and program. Perhaps more accurate forecasts could be achieved for institutions under 500 to 1000 student enrolments, by utilizing a total Grade XII population survey; however, in many instances the lack of accuracy also reflects the smaller institutions' weak market position. Thus far the model has correctly forecasted the trend of enrolments for institutions around 1000; however, the degree of error has exceeded 5% on several occasions. A size threshhold at which both accurate enrolment trends and percentage change appear would indicate the need for enrolments of approximately 2,000 or more students.

5. Full-Time Students.

Applicability of the model to full-time student enrolments is most encouraging in terms of overall outcomes. Part-time forecasting efforts thus far suggest the need for further research and development and perhaps the use of a community wide household survey to reach the potential enrollee who left high school several years earlier.

IMPLEMENTATION PROBLEMS.

1. Supply Side.

Application of this cross-pressure impact methodology calls for near "real time" response by both the supply and demand components. The student survey and follow-up snapshots achieve this for the demand side. However, institutional supply side constraints for both the current and the next year have frequently been less than adequate and have forced the forecaster to assume supply side conditions of the previous year. The operational status of a management information system for the universities will shortly overcome many of these institutional data problems.

2. Short-Term Economic Change.

The forecasting methodology is vulnerable to the short term swings in the economy and particularly vulnerable over the summer months, from May to September. A backup sample may be required on occasions to account for very late shifts in behaviour.

3. Terms of Reference.

On the institutional supply side there is an understandable reluctance to disclose the outcomes of selection-constraint policies on the current Grade XII class when such a disclosure might reflect adversely on an institution or cause the oncoming Grade XII class to "select themselves out" by not even applying. Terms of reference are required between both the institutional supplier of data and the forecaster user.

4. Guidelines.

High demand institutions should refrain from last minute changes or re-interpretations of admission or quota criteria as these can impact beyond the program to other programs and institutions, with marked effects on their enrolments and resultant budgets. Without guidelines agreed to by all such institutions, an admissions competition could spread and introduce unforecastable crisis in a system.

SUMMARY OBSERVATIONS.

In summary, the cross-pressure impact methodologies applied in Manitoba disclose reasonable signs of utility in a seed bed environment with something less than ideal support. In some areas of particular weakness the required data is available on the horizon by way of "real time" supply data inputs from the computer network.

A personal observation of the author would be that the full potential and power of this methodology has been overshadowed by the obvious crisis in enrolments and

an overriding priority for reliable forecasts to run our resource allocation models. This methodology as applied first in its survey form and later in real life high school gaming simulations called the "Post Secondary Option Game" provides us with both the explanations for the gaps between intentions and enrolments and some of the means to change the outcomes. For example, the gap between intentions and behaviour disclose a number of individual, family, financial and institutional constraints in the forms of inadequate decision-making data, timing of data precluding exercise of options, and traditional institutional activities and non-activities which preclude options. Further, for substantial numbers of first year students who do enrol these constraints often re-appear as key factors in the high rates of stepping out. Also, Post-Secondary education emerges as only one of many options available to our youth. In particular, attractive employment options represent a very serious competitor for some of our best talent.

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